Art. XXX.—*Notes on the Blepharoceridae (Diptera) of New Zealand.*

By J. W. Campbell.

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Attention was first drawn to the occurrence of Blepharoceridae in New Zealand by Dr. Charles Chilton (1906), who described a larva which he pointed out closely resembled that of *Curupira torrentium* F. Müll. Seven years later Mr. C. G. Lamb (1913), of Clare College, Cambridge, described, from material supplied by Mr. G. V. Hudson, two new genera and species of Blepharocerid flies. The first of these, of which only males were known, was called *Neocurupira hudsoni*, and the second, which was represented by both sexes (the females immature), was named *Peritheates turrifer*. In the following year Professor Mario Bezzi (1914) published descriptions of three larvae which he had received from Dr. Chilton. He designated them larva A, larva B, and larva C, the first of which was identical with Dr. Chilton's "larva ? *Curupira*," and "probably *Neocurupira hudsoni* Lamb." (Bezzi, 1914, p. 118.)

In November, 1919, Mr. W. G. Howes, of Dunedin, and the present writer took specimens of a third fly, intermediate in size between the two described by Lamb, while in December of this year Mr. T. R. Harris, of Ohakune, captured a fourth. These two flies are described in this article, some notes on larval forms being also given.

There seems to be some uncertainty as to which of the larvae A, B, and C belong to the two flies described by Lamb. Bezzi associated *Neocurupira hudsoni* Lamb with larva A, and *Peritheates turrifer* with larva C, leaving larva B unrepresented in the imago. He writes, "The first of the two genera described by Lamb, called *Neocurupira*, belongs to my second subfamily Paltostominae, and apparently differs only in the much longer proboscis from the Brazilian *Curupira*. But I have already shown how this character is an uncertain one, while both the characters of the *assumed larvae* [the italics are mine] show the dorsal covering to have a greater number of spines than in *Curupira*, where they are inserted on special tubercles. The new species *Neocurupira hudsoni* Lamb, on account of its colour, aspect, and dimensions, closely corresponds with *Curupira torrentium* and other allied forms in Brazil." (Bezzi, 1914, p. 116.) Referring to the larvae, he says (p. 117), "One of them I believe is certainly related to *Neocurupira*, while the other two belong to the Apistomyinae, and the smaller of these is *Peritheates*." He continues (p. 118), "I shall therefore call the first larva A, which apparently belongs to the group *Curupira* in possessing dorsal spines and tracheal gills not arranged in tufts"; and further (p. 119), "In proportion this larva is much larger than the others." Larvae B and C he describes as with "dorsum unarmed and bare" (p. 122-23).

My own observations on these larvae are that all three have a dorsal armature with special tubercles corresponding in number and position on their respective segments—*i.e.*, 12 cephalothoracic, 14 on each body-segment, and 18 on the double 6th segment. The primary spines on A are large, sharp, and black in colour; those on B and C are transparent and cone-shaped. The larva B is larger than the others, as it should be if it is, as I suspect, related to *N. hudsoni*.

Bezzi describes the gills of the larvae as follows: Larva A—"Tracheal gills in single series, those of the anal clump distinct" (1914, p. 118). Mr. D. Miller, who has translated Bezzi's useful paper,* after examining Dr. Chilton's specimens says, "Not distinct, apparently six in number." Larva B—"Tracheal gills forming a small indistinct tuft near the anterior margin of the segment, those of the anal tuft apparently distinct" (p. 118). Larva C—"Suckers large, while the tracheal gills placed on the anterior margin of the segment are small but distinctly visible" (p. 124).

Bezzi was not quite certain about the gills, and he makes no note of other important characters; but this can be understood, as his specimens appear to have dried up. His description of the tracheal gills of *Curupira* is: "Tracheal gills not arranged in tufts, but forming 2 rows running from the anterior to the posterior margin of the segment, one on the right, the other on the left of the sucker, consisting of from 6 to 8 gills in each row; anal tuft composed of 4 branches, antennae very short, 2-jointed, lateral processes simple but very short, dorsum bearing powerful spines." (Bezzi, 1913, p. 76.) In *C. torrentium* there are 8 tracheal gills in each row.

Excepting the number of dorsal spines, this arrangement agrees fairly closely with that found in larva A. Moreover, a comparison of figs. 1 to 27 will show that in the form of the dorsal spines and the arrangement of the

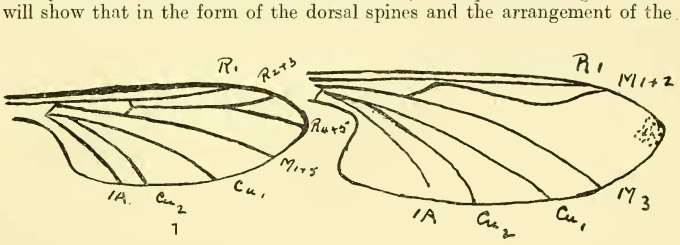


FIG. A.—1. Wing of *Curupira torrentium* (F. Müll.), (after Bezzi).
2. Wing of *Apistomyia elegans* (Big.), ♀.

tracheal gills larva A stands apart from larvae B and C, which resemble each other in dorsal armature, but differ in the form of the *lateral* processes (figs. 38-40) and in the number and arrangement of the gills. Larva A apparently belongs to the Paltostominae, and larvae B and C to the Apistomyinae.

To turn now to the imagines: Bezzi gives a diagram of the wing of *Curupira torrentium* F. Müll. (see fig. A, 1, of this article) which shows this

* Mr. Miller's manuscript translation is deposited in the Dominion Museum, Wellington.

wing to be very different from *N. hudsoni* Lamb in the form of the anal angle of the wing and the radial fork, while the form of the anal angle of the wing of *N. hudsoni* is similar to that of *Apistomyia elegans* (fig. A, 2), though the radial fork shows a different stage in reduction in these two forms. Bezzi has also pointed out (1913, p. 68) the close resemblance of *Apistomyia elegans* to *Apistomyia collini* from Australia. Further, the subcostal vein is evanescent in *P. turrifer* (figs. 48 and 53); it is small in *N. hudsoni* (figs. 44 and 50); and is still well developed in the first new species about to be described (figs. 47 and 52). All these characters in the venation, and the larval characters, require, in my opinion, that *N. hudsoni* and *P. turrifer* be placed in the Apistomyinae, while the new fly, herein described under the name *Curupira chiltoni*, should be placed in the Paltostominae. Moreover, the larva A of Bezzi is a Paltostomid, and is, I believe, that of *Curupira chiltoni*, while larvae B and C, being Apistomyids, belong respectively to *N. hudsoni* (or a similar fly) and *P. turrifer*. Support is given to these relationships by the distribution of the larvae and imagines—*e.g.*, in a stream at Purau *Peritheates* and larva C are found together with *Curupira chiltoni* and larva A, but I have never taken either larva B or *N. hudsoni*. I hope, however, to confirm or disprove the suggested relationships, at least of larvae A and C, during the coming season.

Referring, in a letter to the author, to the position as stated so far, Professor Bezzi points out that there may be other larvae more nearly approaching his description of B and C—*i.e.*, "dorsum unarmed and bare"—and that other Paltostomid flies may be found. The discovery of the fourth fly from Ohakune has in at least one respect confirmed Professor Bezzi's opinion. This fly closely resembles *N. hudsoni* Lamb, but the vein R has lost its fork, and the wing is smaller. The assumed larva (from Ohakune) of this fly, which I propose to name *Apistomyia harrisi*, closely resembles the Otira larvae, which I take to be those of *N. hudsoni*. I have also from Queenstown a Blepharocerid larva (fig. 29) which has distinct characters, and is probably a closely related but undiscovered fly.

Returning again to Bezzi's figure of *Apistomyia elegans* (fig. A, 2), it should be noted that Bezzi's enumeration differs from that used in this paper. His M_{1+2} is R_3; R_2 has disappeared; the basal portion of his M_{1+2}, up to where it touches R_1, is really part of R_{4+5}; M_{1+2} is not represented, except that basal part marked M and *r–m* (fig. 46). The lost veins are dotted. This appears to be confirmed by the primitive wing-venation of *Edwardsina chilensis* Alexander; and, furthermore, fig. 49 shows the bases of insertion of the macrotrichia of R_{2+3} on the wing-membrane of *A. harrisi*. If *N. hudsoni* and *P. turrifer* be Apistomyids, we have, with *A. harrisi* n. sp., three distinct stages in wing-reduction in this ancient subfamily.

Curupira chiltoni n. sp. (Figs. 55 to 75.)

Head: Vertex small, finely pubescent, occupied by the large ocellar turret, around which is a number of stiff bristles. One ocellus anterior, the other two placed laterally. Space between the eyes projecting out to form the raised keel described by Lamb. This space is narrower in the ♂, and in both sexes appears broader as it approaches the base of the labrum. Eyes hairy, dichoptic, bisected in both sexes, upper eye-facets larger.

A single hair arises from each angle of the hexagons (fig. 65). Labrum and hypopharynx as in fig. B. Internally the labrum bears strong single, double, and triple spines turned back from the point of the strong beak. This seems to suggest that our Blepharocerids may prey on other insects, otherwise this armature seems unnecessary (fig. 70). Mandibles present in ♀ (fig 69), absent in ♂. Maxillae present in ♂ (fig. 64), absent in ♀ (figs. 69 and 74). Labium (fig. 57) long, geniculate, divaricate. Antennae (figs. 62, 71, and 72) usually 14-jointed. Palpi (figs. 63 and 73) short, 2-jointed.

Thorax of normal form for the family, microscopically pubescent, with a definite chaetotaxy. Halteres long-stalked.

Legs (fig. 83): Relative dimensions and characters as in *P. turrifer*, two spurs on tibiae of hind legs, claws simple, empodium rudimentary. The colour-scheme is black, with a silvery-grey appearance, probably due to light-effects. Slight orange colour near the humeral knobs and wing-bases, legs lighter in colour on the trochanters and bases of the femora.

Wings (fig. 47) ground-glassy in appearance with dark veins, anal angle obtuse as in *Curupira*, membrane covered with fine microtrichia. Costa covered with strong macrotrichia, as many as 9 in the rows, corresponding to the primitive veinlets. From the margin of the wing just beyond R_3

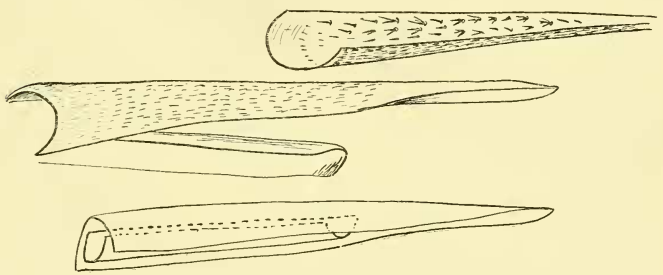


Fig. B.—Labrum and hypopharynx of *C. chiltoni*, ♂.

fine cilia continue round the wing to the base. The cilia increase in length as they approach the angle. Reduced Sc is more strongly marked than in the other three flies. Some of the bases of insertion of the macrotrichia still carry the spines. R_1 is a simple vein; R_{2+3} forms a fork; both R_2 and R_3 turn upward near the margin. M fuses with the angle of R_{4+5}, picking up the original *r–m* in the fusion. Cu_1 arises as a strong vein, fuses with the persistent fourth branch of M, forming a fork. The last vein is 1A or 2A. Here again I have taken the wing of *Edwardsina chilensis* (Alexander) as an indication of the lines of reduction. All four wings show the signs of reduction, making an interesting series, which may be clearly seen in the region of R_{4+5}, and to which I have referred previously in regard to the persistent bases of the macrotrichia.

Abdomen (figs. 86 and 87): ♂ with the characteristic laterally compressed and turned-up appearance; ♀ larger, round, and tapering. Body-segments with scattered bristles, more numerous near the margins of the segments. Ventrally on each segment are three groups of bristles

(about 12–15 in each) forming a triangle with the apex anterior (figs. 88 and 89).

Hypopygium: ♂ as in fig. 93, ♀ as in fig. 94.

Loc.—Otira; Banks Peninsula, Purau.

Type in my collection.

Apistomyia harrisi n. sp. (Figs. 96 to 109.)

Head (figs. 97 and 98) with large and prominent turret. Eyes bisected and dichoptic in both sexes, upper eyes small, occupying about $\frac{1}{4}$ of the whole eye. Antennae 12-jointed. Labrum (figs. 99 and 101) sharply pointed, distinctly hairy, and terminating in a strong short spine. Internally the same type of barbs turned back from the point as in *C. chiltoni*. Hypopharynx (figs. 101 and 102) short, thick, and grooved. Maxillae (fig. 96) present in ♂, mandibles present in ♀. Labium (figs. 97, 108, and 109) long, geniculate, and divaricate, more strongly setose than in the other three flies, the labella show pronounced sensory organs at the tips. The labella of the ♀ are shorter and abruptly tapering at the tip (fig. 109).

Thorax (fig. 115) normal, finely pubescent, chaetotaxy definite. Halteres long-stalked and pear-shaped. Legs of the characteristic type, hind femora long, tibial spines large, rather longer and thinner than in *N. hudsoni*. Legs of ♀ proportionately shorter than in the ♂.

Wings (figs. 45 and 46): Wing of ♀ larger than that of ♂ (the dotted lines show the primitive position of the absent veins). Fig. 49 shows the bases of the macrotrichia near the cross-piece of R_{4+5}. No other wing in these flies has been noticed with the bases of the macrotrichia in this position.

Abdomen with scattered hairs on each segment, with the groups of hairs ventrally as in *C. chiltoni*. In the ♂ it is laterally compressed and turned up at the end; in ♀ it is cylindrical, tapering posteriorly. Hypopygium in the ♂ of the same type as *C. chiltoni*, claspers long and bristly. The ♀ hypopygium has broad laminae, and the area surrounding the ovipositor is covered with a number of large and long tubercles, from the centre of which projects a stiff blunt short spine. Laterally two short hairy processes project from the last segment, armed at the tips with the same type of tubercle and spine.

Colour: The general colour is grey to black. Thorax a deep black dorsally. The mesothoracic suture is interrupted; the middle third of the V of the tipulids is absent. Bezzi quotes Osten Sacken (1913, p. 89), "thoracic suture distinct, not interrupted in the middle," and refers to the importance of this character (1914, p. 89). In *C. chiltoni* and *A. harrisi* the lateral margins are yellow, and the yellow shows as a trident-shaped marking in fresh specimens between the lateral prominences of the scutellum of the mesothorax (fig. 115). Darker markings show round the junction of the femora and trochanters.

Loc.—Ohakune, North Island.

Type in my collection.

Larva of *A. harrisi*.—The Ohakune larvae, which I take to be those of *A. harrisi*, have similar characters to the Otira larvae (? *N. hudsoni*), but in all stages the latter is the larger. In colour dorsally there is little to

choose between them, both being uniformly dark-coloured. Ventrally, however, the Ohakune larvae are lighter in colour. The gill-filaments increase in number with the age of the larvae, stages with 2, 4, and 7 filaments having been observed. Edwards (1915, p. 208) has noted a similar increase in *Elporia barnardi*.

Notes on Eggs, Larvae, and Pupae.

Eggs. (Figs. 84 and 85.)

Slide specimens of the adult female *C. chiltoni* show the elliptical egg, contrasting with the egg of *Bibio johannis*, which is cylindrical with abruptly rounded ends. The egg-membrane and the granulated contents separate in slide preparations, and the membrane appears covered with round bosses, corresponding to the developing external layer of cells of the egg. Eggs that I have found adhering to the underside of stones in a creek are brown in colour. During the last stages they show distinctly darker on one side. With a good top lighting, low powers show that the dark side is the dorsum of the contained larva. Each segment has 4 spines, and the antennae and the central plate of the cephalon are clearly discerned. The light side shows the 6 circular dark rings of the suckers and the faint outline of the lateral processes. No evidence is available as to how the

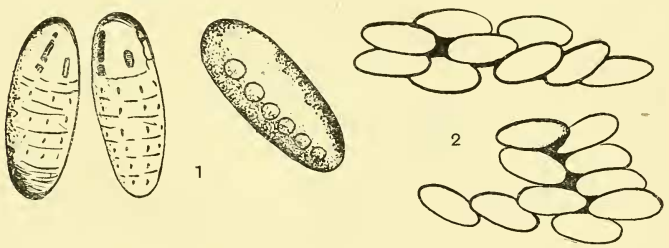


Fig. C.—Blepharocerid eggs. 1. Showing patches of eggs. 2. Magnified to show developing larva.

fly places the eggs on the stones beneath the water. Freshly emerged larvae appear to have only the anal set of gills; the next stage includes the addition of one gill on each side for the other segments, and the total number of gills is reached before the last moult. Spines and gills increase during the moulting stages. Further search has confirmed my opinion in regard to Purau Creek. The Blepharocerid there is *C. chiltoni*, and after careful search I failed to get a single specimen of *turrifer*. The flies have a habit of sitting on the stones with the long hind legs touching the margin of the running water. With each increase of the flow of the water the fly will be pushed up about $\frac{1}{4}$ in. or more, but each time the fly merely backs down to the original position. It seems probable that the female dives under to lay; otherwise it seems difficult to account for the eggs adhering in patches, at depths far beyond the reach of the insect.

Larvae.

Head (fig. D): Bezzi (1914, pp. 119, 122, 123) describes the colour-scheme of the frontal spot on all three larvae. The frontal spot is a special plate forming the dorsal prominence of the cephalon. It is subquadrate, rounded posteriorly, the lateral portions separated from the remainder of the segment by well-defined connecting membrane. In the centre lies a definite separate elliptical plate, placed longitudinally, tapering sharply at the ends, and suggesting some relation to the process of pupation, or moulting stages of the larvae (fig. 125).

Dorsal armature (figs. 1 to 37): In addition to the primary spiny armature, all three larvae bear numerous spines, ranging from a minute single hair, or a group of single hairs (palmate), through the type of cone or double cone, up to the many varied types of fan-shaped spines. A study of these spines strongly suggests an evolutionary series. The largest fan spines range themselves in rows near the anterior margins of the segments and form groups near the base of the lateral processess. Each

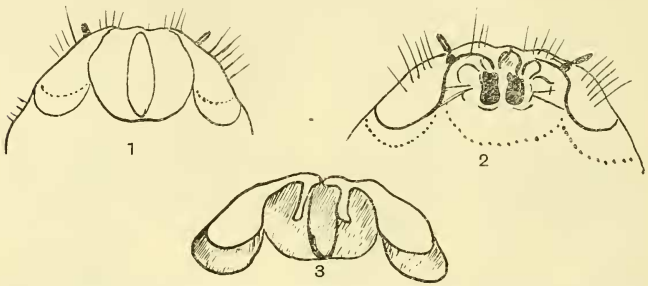


Fig. D.—Cephalon (diagrammatic) of larva. 1. (Dorsal) showing central plate. 2. (Ventral) showing mouth-parts. 3. (Ventral) showing relation of dorsal and ventral portions.

segment has also many special flat cells or groups of cells scattered over the dorsum (figs 117 to 121), and these also are arranged in rows near the outer portion of the anterior margins of the segments. Larva B has a thickly-scattered armature of transparent fan spines, and these approximate so closely to the main armature in size in many cases that it is difficult to pick out the cones from the fans (fig. 119). The integument on all three larvae shows a well-defined zigzag appearance. At the margins of the segments this resolves into the scale-like minute processes of the integument (fig. 120). A view along the margin shows them V-shaped or W-shaped like the teeth of a saw. In *B. johannis* the scale processes have a minute terminal spine. I can detect no terminal spine on these processes in the Blepharocerid larvae. The three types of lateral processes (figs. 38 to 40) are distinct in their form and in the type of the spines or hairs connected with each.

Posterior marginal spines (figs. 41 to 43): Larva A averages 40 spines in a double row laterally, merging to a single row towards the centre of the margin. Larva B has about 30 spines in a single row, as also has larva C.

In A and C there is a secondary ventral row of about 10 spines, and in B there is a secondary row of about 30 spines. In all three the secondary spines are short and stout.

Gills (figs. 10, 11, 12): Larva A has 7 gills in a series on each segment (2 double gills, 1 single proclinate, then a space followed by 2 single reclinate gills). The 4 anal gills are large. Larva B has 7 gills in a tuft on the anterior margin of each segment (2 double and 3 single), the anal gills large. Larva C has 4 gills in series on the anterior portion of the segments (1 double and 2 single), the anal gills large. In all three larvae the two posterior of the anal gills are only one-third the size of the anterior ones. The anal aperture is just in front of the point of attachment of the anal gills, which lie in a semicircular depression between the sucker and the posterior margin of the segment.

Suckers (figs. 122 to 129): The cup of the disc shows fine lines running to the margin of the suckers (fig. 122), where a specialized rim intervenes, the cilia from this point continuing from a rounded basis and tapering to a fine point. The rim shows an irregular pavement appearance, and viewed on cross-section (fig. 123) shows the vertical short pieces of the rim formation. The sucker has 6 tracheal (?) apertures (fig. 130), and the anterior margin has a specialized valve gateway (fig. 127). Underlying the disc appears a fine transparent pellicle showing very fine marginal cilia. Palmate hairs, similar to the type found on Culicid larvae, are found near the suckers.

Mouth-parts (figs. 131 to 137): The mandibles are large, black, and bidentate, the tips of the cusps transparent. The maxillae are complex and difficult to determine; they are densely hairy, with a biting-area bearing small cusps. The labrum bears 2 strong spines on its broad base, and tapers distally as a long brush lying between the mandibles. The labium is short, densely hairy, and subtriangular; the palpi appear as 2 small oval buttons marked with 2 large round black spots with 6 or 7 small dots between them. The palpi and maxillae, and perhaps the mandibles, have brushes or bunches of hairs, but the general crowding-together of hairs makes definition extremely difficult from whole (slide) specimens. The mouth-parts are set in a depression bounded anteriorly by a raised rim, behind which lies the base of the labrum. Darkly chitinized lateral boundaries show prominently, and carry the origins of the powerful muscles and ligaments. Strong bristles are inserted along the rim and the lateral portions of the segment. The developing pupa, contained within the larva, and with its breathing-tubes chitinized to about half their length, shows stages of development of the future adult mouth-parts (figs. 138 to 141), and at the base of the developing mandibles, &c., appear branched hairs similar to those found on larvae of *Culex* and *Anopheles* (fig. 139). These special hairs I have not found externally on the larvae or adult flies.

Alimentary and tracheal systems (figs. 142 to 145): The alimentary system, lying centrally, shows diverticula in the form of chitinized pouches (fig. 126) lying about half-way towards the lateral margin. The tracheal system shows strong vessels passing round the margins of segments, and the areas occupied by the dorsal marginal rows of spines. Branches appear to pass from the gills to the suckers terminating in the 6 apertures. The spiracles (closed) (fig. 124) of the larva lie at the base of the lateral processes. One seems forced to assume that the tracheal apertures of the disc have a perfectly transparent membrane over the aperture, or that the tubes (visible) (fig. 130) have no connection with the tracheal system proper. Bearing in mind the peculiar dorsal armature following the tracheal system, and the

specialized cells of the dorsum, it seems possible that the gills and discs are connected by a system of air-tubes relating to suction alone, and that the opening and closing of the disc is aided by the use of the valve-gateway at the anterior margin of the disc. The mechanics of the disc action, however, need further research.

Pupae.

Bezzi (1913, p. 80) describes the pupae as "oval in shape, convex and strongly chitinized dorsally, where the colour is black, and flat and whitish ventrally. The prothoracic respiratory appendages project forward in the form of two horns, enclosing the delicate respiratory organs." The following notes can be added: When examined under a high power the black dots resolve into small brown raised bosses (fig. 150). Dark markings appear at the lateral margins, where they curl over to form the rim of the cradle for the enclosed occupant (figs. 147 and 149). A group of light-brown spots appears on each segment, half-way between the centre and the margin, but these are only visible on slide specimens (fig. 149). Each respiratory appendage consists of 4 plates.

The presence of Blepharocerid larvae in the vicinity of Dunedin and Queenstown brings the area of distribution considerably farther south than the 40° mentioned by Bezzi (1913, p. 71). Dunedin is nearly 46° S latitude. Altitudes: Dunedin, about 600 ft.; Queenstown, 2,000 ft.; Arthur's Pass, Otira, from 1,260 ft.; Ohakune, 2,018 ft.; Purau, about sea-level.

I have to express my keen appreciation of the kindly interest taken in my work by Dr. Chilton, Mr. Gilbert Archey, and many other friends, and of the valuable help they have given me in my attempt to increase, however slightly, our knowledge of the New Zealand representatives of this family.

Literature cited.

Bezzi, M., 1913. *Bull. Soc. Ent. Ital.*, vol. 44, pp. 1–113.
—— 1914. *Ibid.*, vol. 45, pp. 115–29.
Chilton, C., 1906. *Trans. N.Z. Inst.*, vol. 38, pp. 277–78, pl. 46.
Edwards, F. W., 1915. *Ann. Mag. Nat. Hist.*, ser. 8, vol. 16, pp. 203–15, figs. 1–22.
Lamb, C. G., 1913. *Trans. N.Z. Inst.*, vol. 45, pp. 70–75, figs. 1–9.

Note.

In regard to my enumeration of the wing-veins, Dr. Tillyard has kindly pointed out the improbability of any fusion of R and M in the Blepharoceridae. The error is mine, and bears no relation to the evidence for wing-reduction in New Zealand forms.

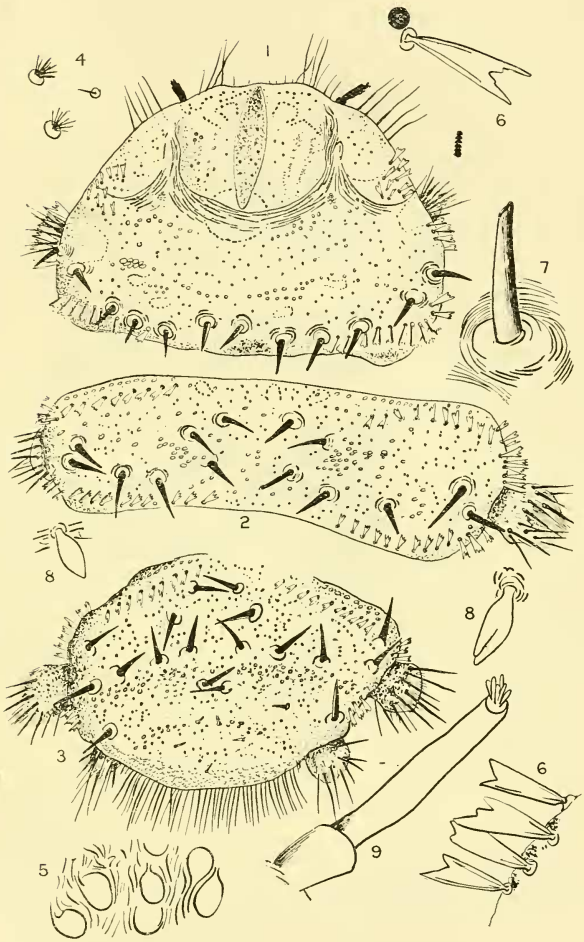


Fig. 1.—Larva A: 1st segment.
Fig. 2.—Larva A: body segment.
Fig. 3.—Larva A: 6th segment.
Fig. 4.—Larva A: palmate spines.
Fig. 5.—Larva A: group of cells.
Fig. 6.—Larva A: fan spine.
Fig. 7.—Larva A: primary spine.
Fig. 8.—Larva A: cone spine.
Fig. 9.—Larva A: antenna.

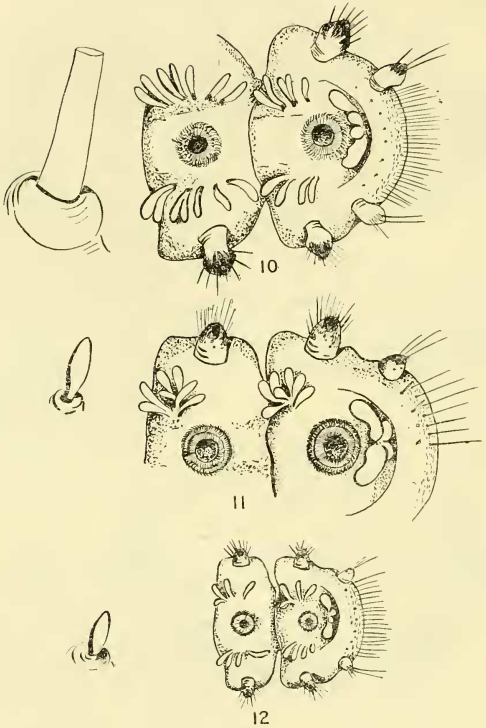


Fig. 10.—Larva A: ventral surface.
Fig. 11.—Larva B: ventral surface.
Fig. 12.—Larva C: ventral surface.

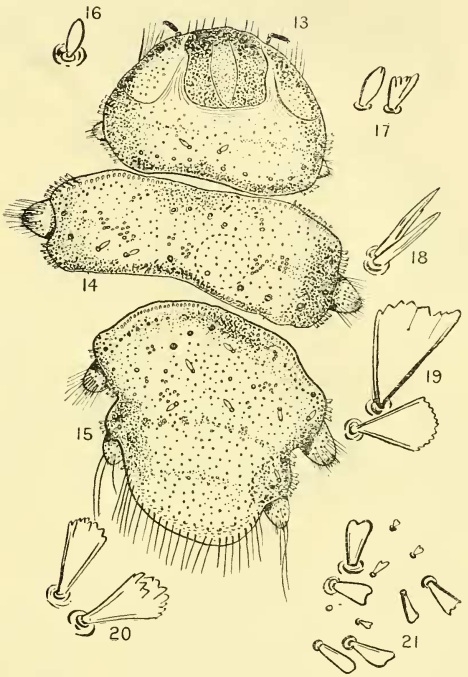


FIG. 13.—Larva B: 1st segment.
FIG. 14.—Larva B: body segment.
FIG. 15.—Larva B: 6th segment.
FIG. 16.—Larva B: primary spine.
FIGS. 17–21.—Larva B: types of spines of dorsum.

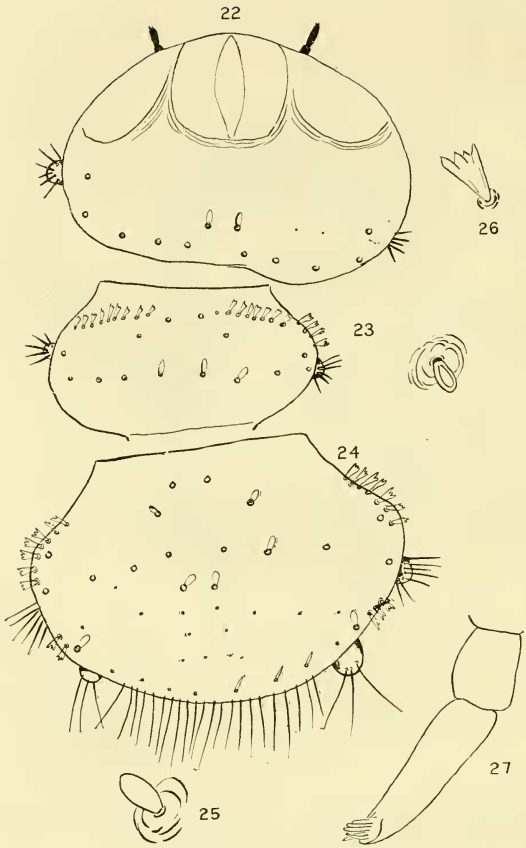


Fig. 22.—Larva C: 1st segment.
Fig. 23.—Larva C: body segment.
Fig. 24.—Larva C: 6th segment.
Fig. 25.—Larva C: primary spine.
Fig. 26.—Larva C: fan spine.
Fig. 27.—Larva C: antenna.

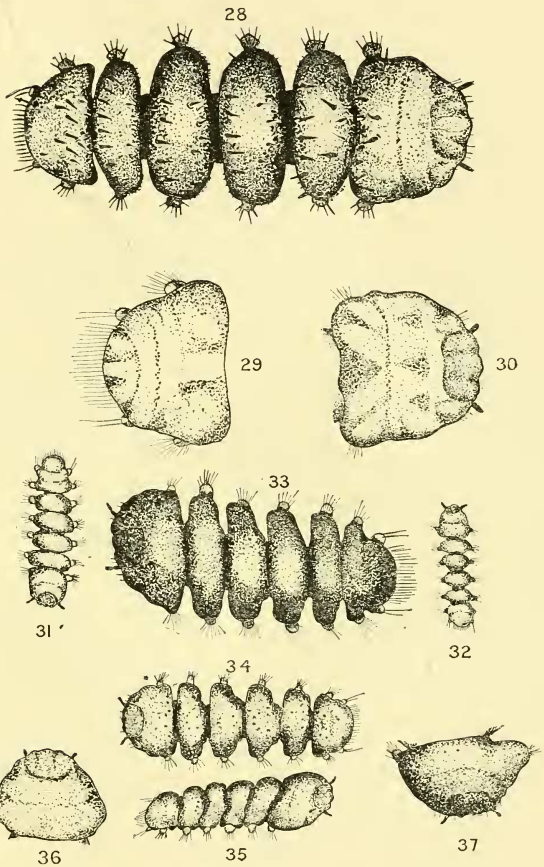
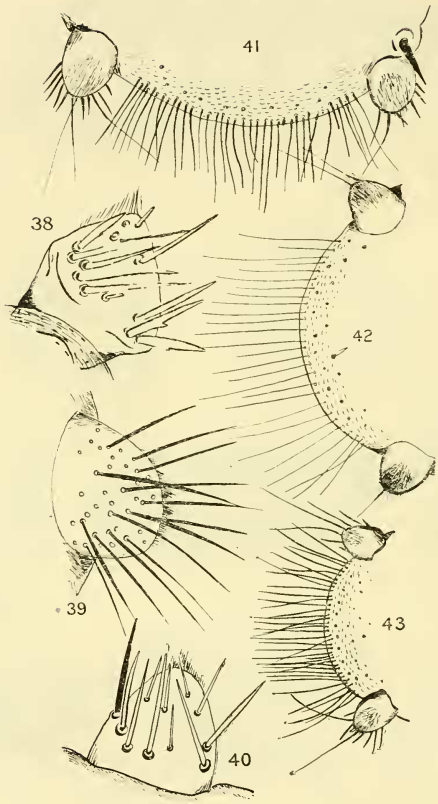


Fig. 28.—Larva A, from Purau.
Figs. 29, 30.—Larva, from Queenstown.
Figs. 31, 32.—Young larva B, from Ohakune.
Fig. 33.—Adult larva B, from Ohakune.
Figs. 34, 35.—Larva C, from Purau.
Figs. 36 37.—Heads of larva B.



Lateral processes and marginal spines, 6th segment.

Fig. 38.—Larva A.
Fig. 39.—Larva B.
Fig. 40.—Larva C.
Fig. 41.—Larva A.
Fig. 42.—Larva B.
Fig. 43.—Larva C.

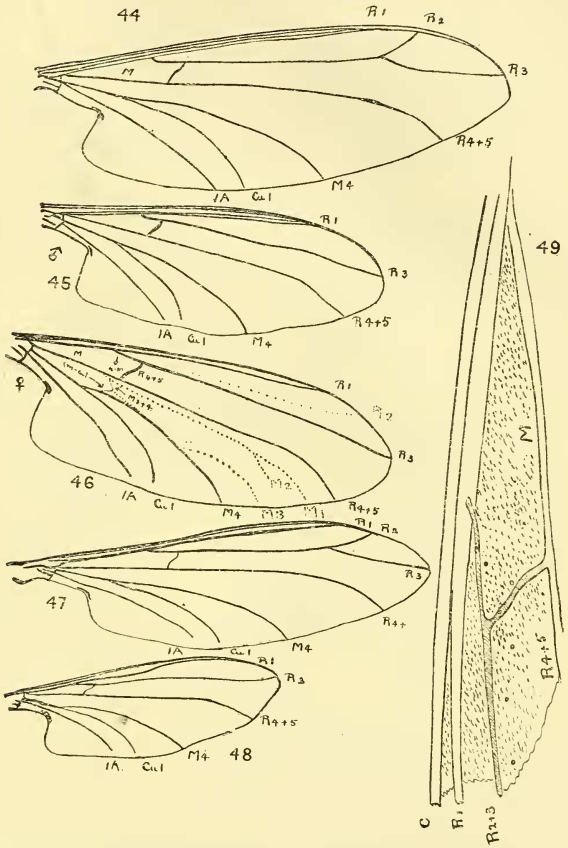


FIG. 44.—Wing of *N. hudsoni*.
FIG. 45.—Wing of *A. harrisi*, ♂.
FIG. 46.—Wing of *A. harrisi*, ♀.
FIG. 47.—Wing of *C. chiltoni*.
FIG. 48.—Wing of *P. turrifer*.
FIG. 49.—Wing of *A. harrisi* showing macrotrichia round R_{4+5}.

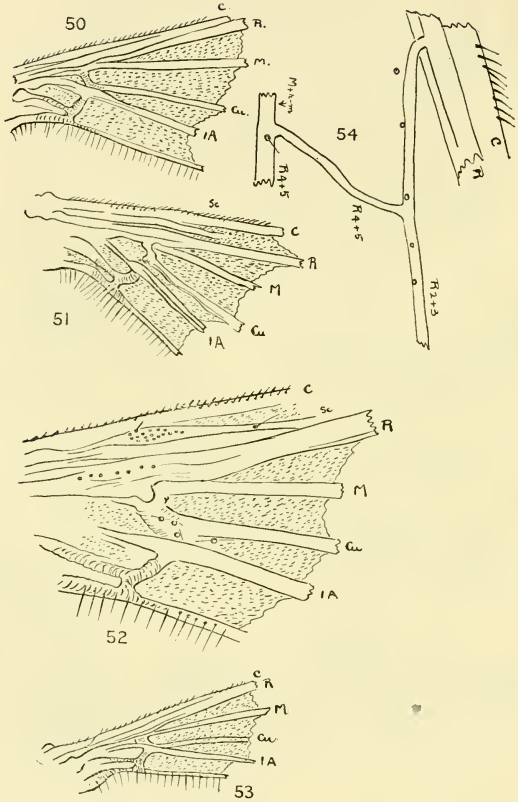
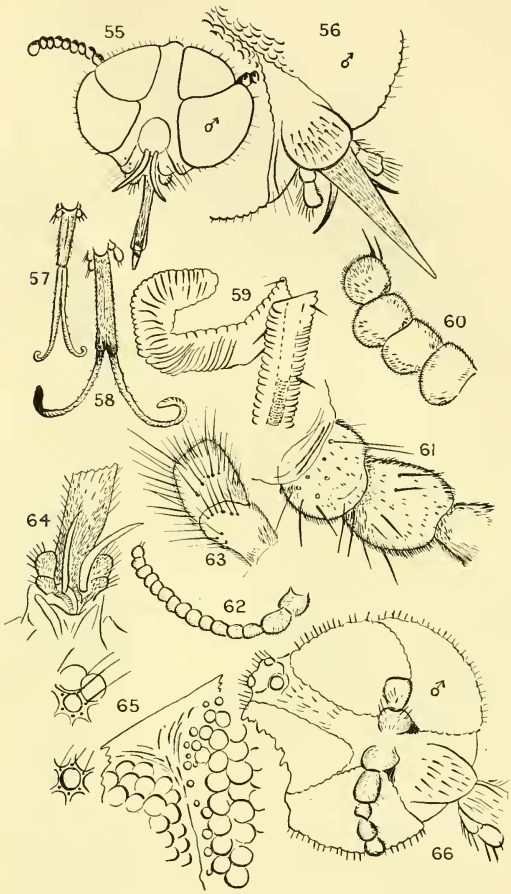
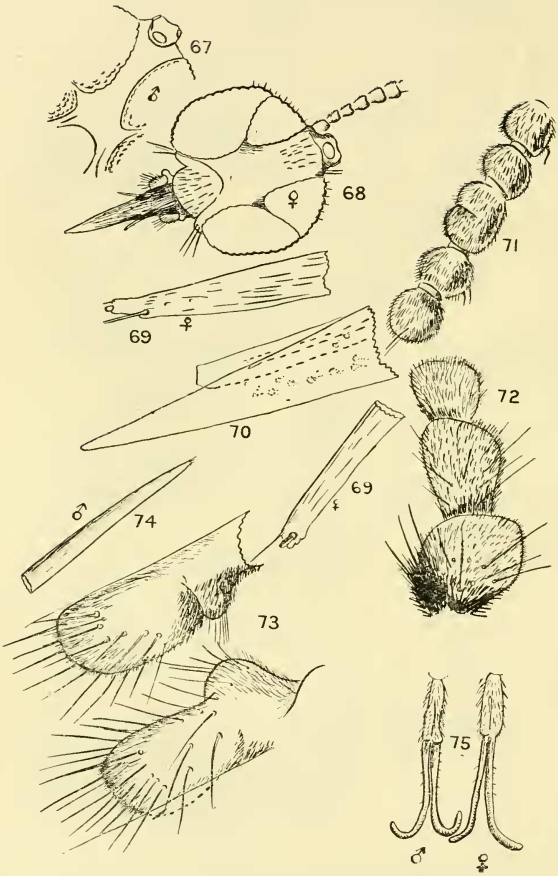


Fig. 50.—Wing-base of *N. hudsoni.*
Fig. 51.—Wing-base of *A. harrisi.*
Fig. 52.—Wing-base of *C. chiltoni.*
Fig. 53.—Wing-base of *P turrifer.*
Fig. 54.—Macrotrichia round R_{4+5} on wing of *C. chiltoni*



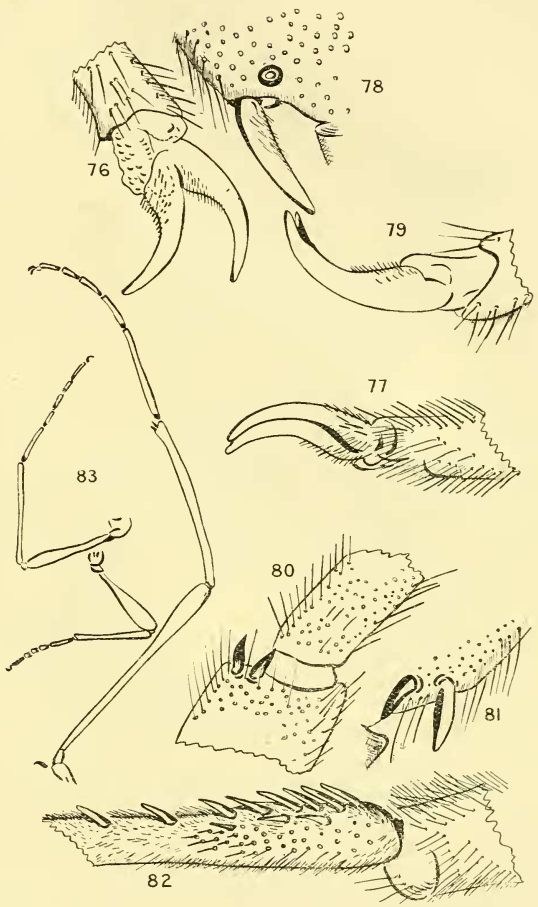
Curupira chiltoni, ♂, excepting figs. 56, 58.

FIG. 55.—Head (view from behind), showing maxillae.
FIG. 56.—Head of *N. hudsoni*, showing *holoptic eyes*.
FIG. 57.—Labium.
FIG. 58.—Labium of *N. hudsoni*, ♂.
FIG. 59.—Tip of labella and portion of same.
FIG. 60.—Four terminal joints of antenna.
FIG. 61.—Two basal joints of antenna.
FIG. 62.—Antenna (complete), 14 joints.
FIG. 63.—Maxillary palp.
FIG. 64.—Part of labium, maxillary palps, and maxillae.
FIG. 65.—Upper and lower eye-facets, showing bisection.
FIG. 66.—Ocellar turret and insertion of antennae.

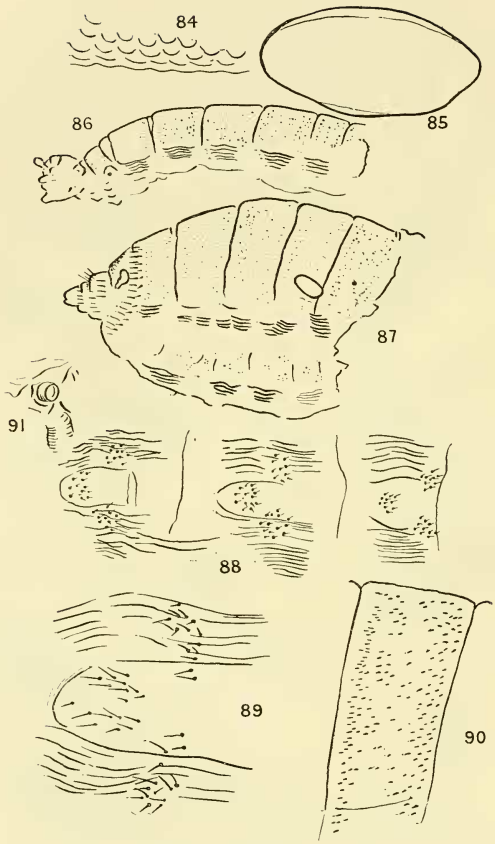


Curupira chiltoni.

Fig. 67.—Head of ♂.
Fig. 68.—Head of ♀, contrasting space between eyes.
Fig. 69.—Mandibles, ♀.
Fig. 70.—Labrum and hypopharynx.
Fig. 71.—Antenna
Fig. 72.—Antenna, basal joints.
Fig. 73.—Maxillary palps.
Fig. 74.—Maxilla, ♂.
Fig. 75.—Labium, ♂ and ♀.



FIGS. 76, 77.—Claws, hind legs of *C. chiltoni*, ♂.
Fig. 78.—Tibial spur of *N. hudsoni*, ♂.
FIG. 79.—Claw, hind leg of *N. hudsoni*, ♂.
FIGS. 80, 81.—Tibial spurs of *C. chiltoni*, ♂.
FIG. 82.—1st tarsal joint, front leg of *C. chiltoni*, ♂.
FIG. 83.—Legs of *C. chiltoni*, showing relative size of the joints.



Curupira chiltoni.

Fig. 84.—Margin of ovum.
Fig. 85.—Ovum.
Fig. 86.—Body, ♂.
Fig. 87.—Body, ♀, showing ovum.
Fig. 88.—Ventral surface of body, showing groups of hairs.
Fig. 89.—Central group (enlarged).
Fig. 90.—Body segment, showing microtrichia.
Fig. 91.—A spiracle.

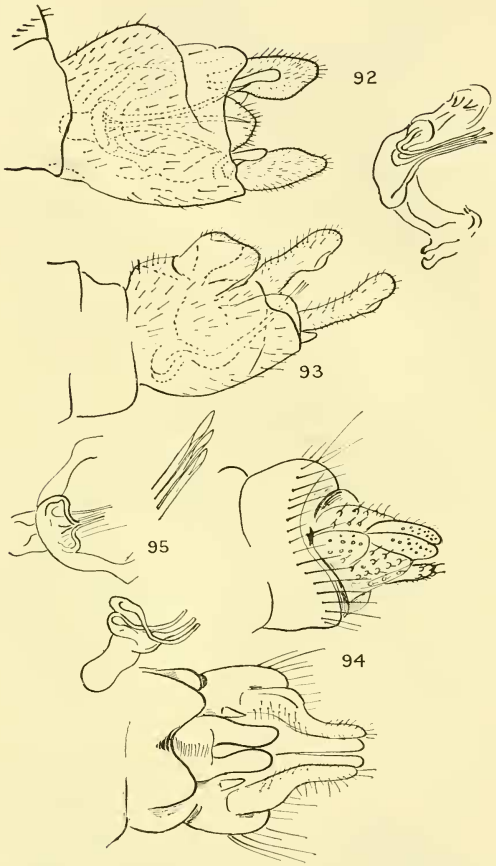
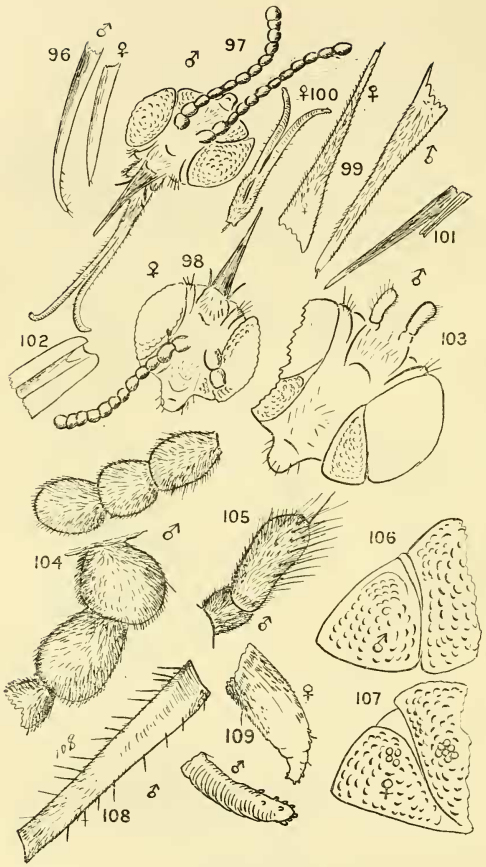
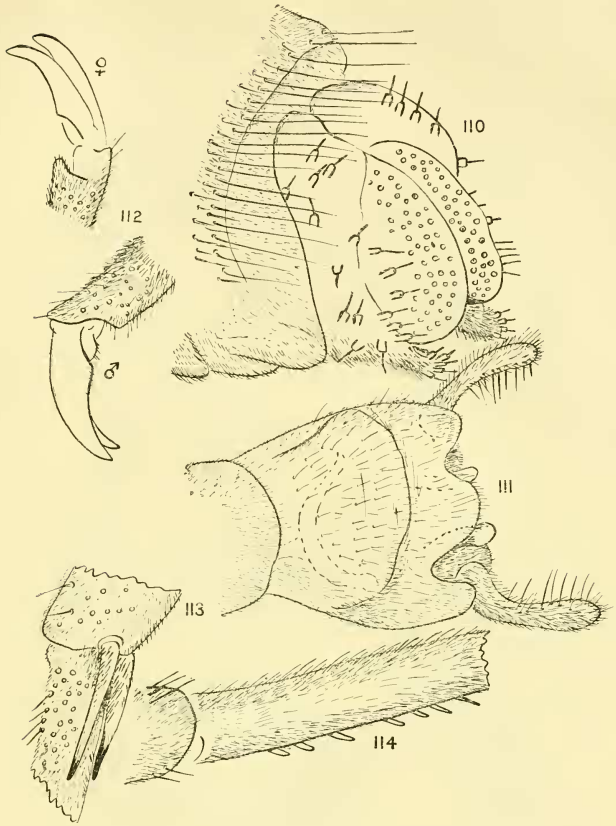


FIG. 92.—Hypopygium of *N. hudsoni*, ♂.
FIG. 93.—Hypopygium of *C. chiltoni*, ♂
FIG. 94.—Hypopygium of *C. chiltoni*, ♀.
FIG. 95.—Penis and bulb of *C. chiltoni*, ♂.



Apistomyia harrisi.

FIG. 96.—Maxilla of ♂; mandible of ♀.
FIG. 97.—Head of ♂.
FIG. 98.—Head of ♀.
FIG. 99.—Labrum, ♂ and ♀.
FIG. 100.—Labium, ♀ (short labella).
FIG. 101.—Labrum and hypopharynx, ♂.
FIG. 102.—Tip of hypopharynx, ♂.
FIG. 103.—Head, ♀ (antennae removed).
FIG. 104.—Antennae, basal joints and tip.
FIG. 105.—Maxillary palp, ♂.
FIG. 106.—Upper eye, ♂.
FIG. 107.—Upper eye, ♀.
FIG. 108.—Portion of labium, ♂.
FIG. 109.—Tips of labella, ♂ and ♀.



Apistomya harrisi.

FIG. 110.—Hypopygium, ♀.
FIG. 111.—Hypopygium, ♂.
FIG. 112.—Claw, hind leg, ♀; claw, hind leg, ♂.
FIG. 113.—Tibial spur, hind leg, ♂.
FIG. 114.—1st tarsal joint (front leg), ♂.

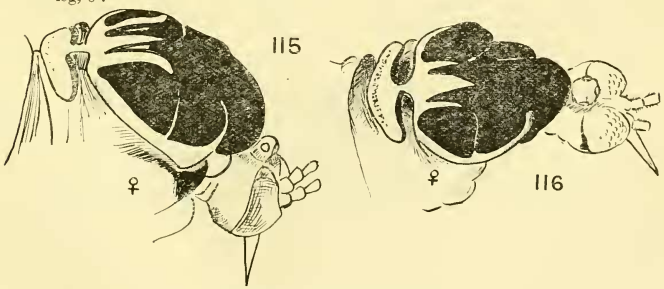


FIG. 115.—*Apistomyia harrisi*, ♀.
FIG. 116.—*Curupira chiltoni*, ♀.

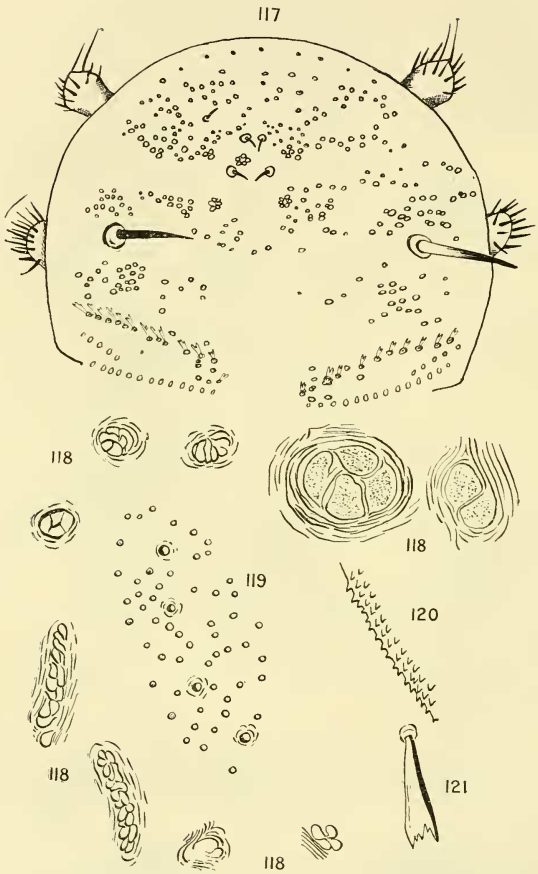


Fig. 117.—Larva A: 6th segment (dorsal), showing special cells.
Fig. 118.—Larva A: special cells, enlarged.
Fig. 119.—Larva B: portion of dorsum, showing four spines of primary armature and secondary spines surrounding them.
Fig. 120.—Margin of integument, showing the scale processes.
Fig 121.—Fan spine, showing thickness.

Note.—The posterior half of the segment shows the reduced remains of the primary spines of the original 7th segment.

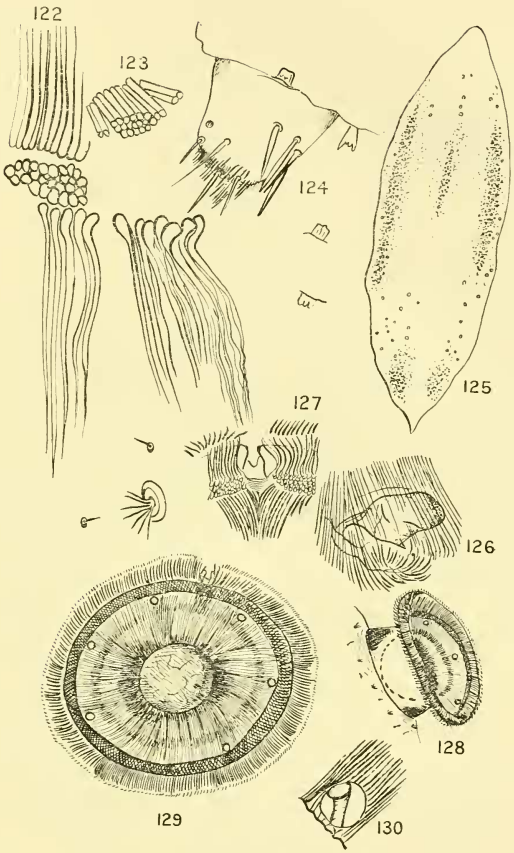
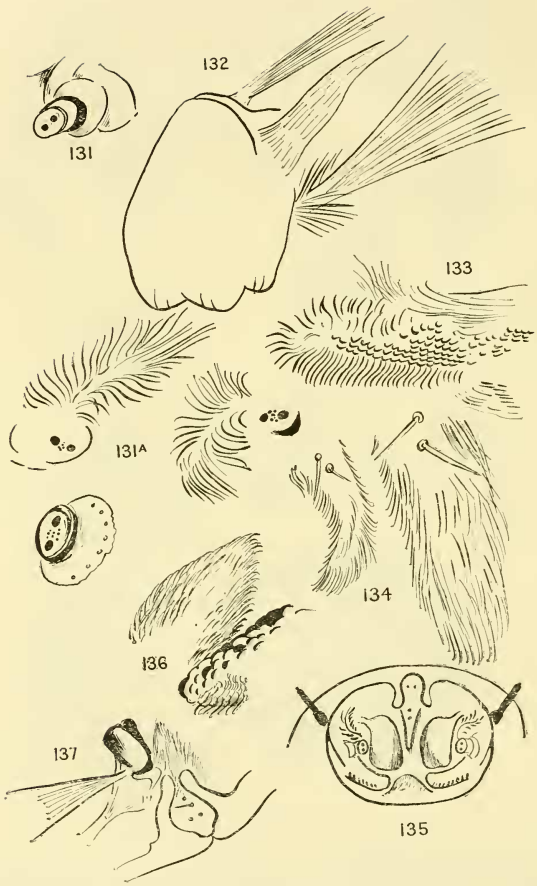


Fig. 122.—Cilia and portion of rim and cup.
Fig. 123.—Section of rim.
Fig. 124.—Lateral process, showing spiracles.
Fig. 125.—Central dorsal plate of larva cephalon (pointed end anterior).
Fig. 126.—Internal diverticula (subdermal) of larva.
Fig. 127.—Valve gateway of sucker.
Fig. 128.—Side view of sucker.
Fig. 129.—Sucker, showing six apertures (palmate and minute hairs).
Fig. 130.—An aperture enlarged to show the tube.



Figs. 131, 131a.—Maxillary palps.
Fig. 132.—Mandible.
Fig. 133.—Maxilla.
Fig. 134.—Labrum.
Fig. 135.—Diagram of arrangement of parts.
Fig. 136.—Labium and part of maxilla.
Fig. 137.—Labrum and mandible.

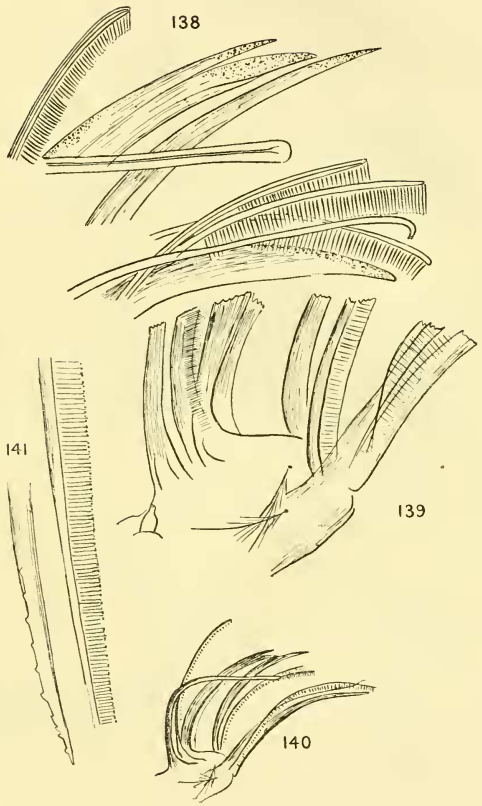


FIG. 138.—Tips magnified.
FIG. 139.—Base magnified.
FIG. 140.—Mouth-parts of future image.
FIG. 141.—Mandible of *Culex* ? sp.

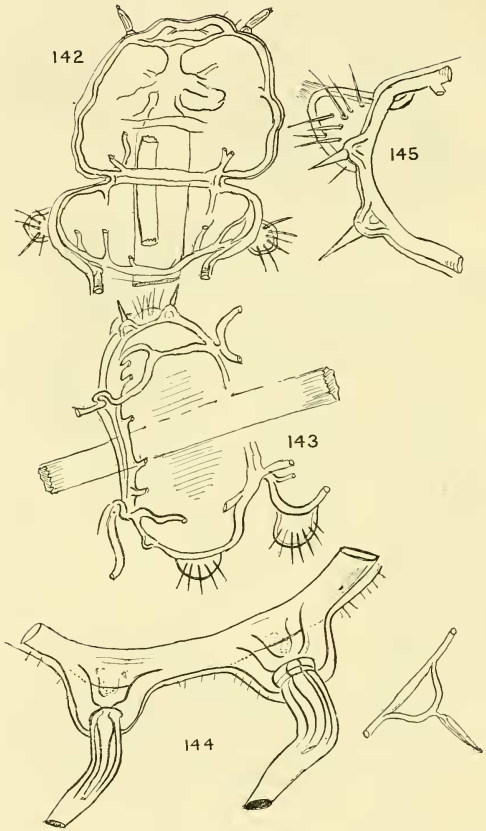


Fig. 142.—Larva A: 1st and 2nd segments.
Fig. 143.—Larva A: 4th segment.
Fig. 144.—Lateral portion of a segment.
Fig. 145.—Two spines and a lateral process.

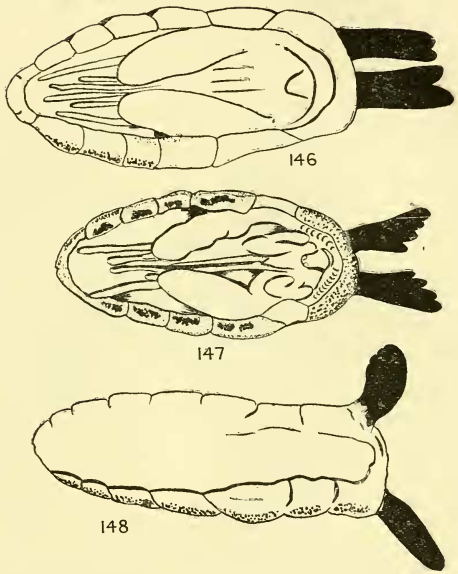


FIG. 146.—Pupa, probably *N. hudsoni*.
FIG. 147.—Pupa of *P. turrifer*, showing antennae, turret proboscis, &c.
FIG. 148.—Empty case of *C. chiltoni*.

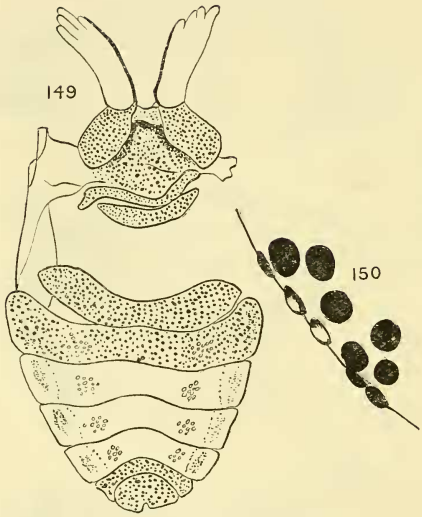


Fig. 149.—Pupa : dorsal view of posterior segments ; ventral view of anterior segments and wing-case : showing how pupa splits for emergence of adult. Central dorsal markings (on slides). Lateral markings are ventral.

Fig. 150.—Black appearance consists of dots. The dots enlarged to show as circular bosses